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Inhalation Therapy



ARE YOUR PATIENTS GETTING THE OXYGEN CONCENTRATION PRESCRIBED?

AUTOMATIC CONTROL UNIT DEVELOPED BY O.E.M. CORPORATION

Recent medical research has emphasized the importance of accurately controlling oxygen concentration in oxygen tents.

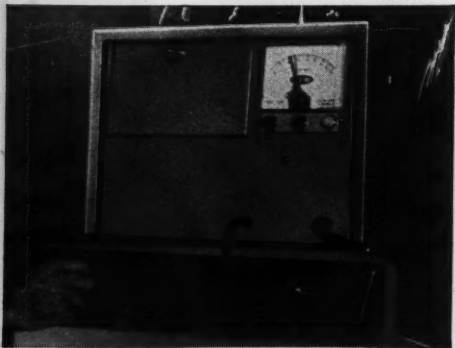
Retrolental Fibroplasia in infants and respiratory acidosis in older patients with pulmonary fibrosis are often caused by indiscriminate use of high oxygen concentrations. On the other hand, high concentrations of 50% to 60% are imperative for many cardiac patients. Research not yet published will point out the need to administer oxygen in controlled dosage like any drug.

CURRENT OXYGEN CONTROL METHODS UNSATISFACTORY

Control of oxygen concentrations in tents has always been difficult, requiring frequent analysis with an oxygen analyzer plus constant adjustment of the flow. Many factors can affect the concentration: Leaks in the tent, poor canopy tucking, inadequate liter flows, failure to use flushing procedures. Even the most elaborate inhalation therapy department cannot afford the necessary technicians to make certain proper oxygen concentrations are maintained.

OXYGEN TENT THERAPY STILL MOST COMFORTABLE

The oxygen tent is the most comfortable method for administering long-term oxygen therapy. There are no encumbering masks, cannulae or catheters to disturb the patient. He retains freedom to move, sit up, talk and eat. Oxygen tent therapy is also the method of choice, or necessity, with delirious patients, in head wound cases and where a modulated temperature is desired during the summer.



NEW ELECTRONIC UNIT ASSURES CONSTANT OXYGEN CONTROL

The O.E.M. Corporation, leader in the development of oxygen tents, has completed a long-term research program designed to solve the oxygen control problem. Result is a new oxygen tent that maintains a preset oxygen concentration automatically, electronically, without attendance.

The desired percentage of concentration is set on a meter — just like the desired temperature. The electronic control unit automatically adjusts the flow of oxygen to maintain the prescribed concentration. This new oxygen concentration

control unit, called the O.E.M. AUTOMATIC MECHANNAIRE, is perhaps the most important advance in oxygen tent therapy since the tent was invented.

HOW THE CONTROL UNIT WORKS

A sample of the atmosphere under the canopy constantly being drawn into a continuous oxygen analyzer. Every 15 seconds, the concentration is monitored. The control unit maintains the concentration within a 6% range.

When the monitor finds the concentration below the range, oxygen at 40 liters a minute is flushed into the tent. There is a visual indication of oxygen is flushing into the tent. Oxygen continues to flush into the unit until the concentration is within the preset range. When the monitor discovers this, the flow of oxygen drops to a maintenance flow of 12 liters per minute... visual indication on the control panel. If the oxygen concentration rises above the desired maintenance flow is cut off and air is flushed into the tent to bring the concentration down.

AUTOMATIC SAFETY VALVE PROTECTS PATIENT

Note that when a lower concentration is desired it is not achieved merely by shutting off oxygen flow. On the O.E.M. AUTOMATIC MECHANNAIRE, an automatic air safety valve starts drawing room air into the tent as soon as the oxygen flow drops below 6 liters per minute. There is no danger of carbon-dioxide buildup because either air or oxygen in substantial quantities is being drawn into the canopy constantly washing out the carbon-dioxide.

CLINICAL TESTING SHOWS ADVANTAGES

Under clinical conditions, the oxygen concentration in a new O.E.M. AUTOMATIC MECHANNAIRE was brought up to 50% from room air in 10 minutes by electronic control. In comparison, more than an hour was required to bring a tent up to 50% concentration at a normal flow rate of 10-12 liters per minute.

The new O.E.M. AUTOMATIC MECHANNAIRE maintained a 50% oxygen concentration for a 24-hour period under clinical conditions... the maintenance flow of 12 liters per minute 90% of the time and on the flush cycle only 4% of the time. It maintained 60% oxygen concentration under clinical conditions on the maintenance flow of 12 liters of oxygen per minute for 90% of the time... and on flush for 10% of the time. Conclusive evidence that the new O.E.M. AUTOMATIC MECHANNAIRE can maintain high concentrations of oxygen for therapeutic purposes with an economical consumption of oxygen.

CONTROL UNIT AVAILABLE FOR MODEL #50 MECHANNAIRES

The O.E.M. AUTOMATIC MECHANNAIRE including tent and electronic concentration control unit sells for \$1,500. The control unit alone which fits any model #50 or #55 Mechannaire is \$850. Control units for model #30 Mechannaire and tents not manufactured by O.E.M. are available on special order at slightly higher price. Additional information on the new O.E.M. AUTOMATIC MECHANNAIRE may be obtained by writing O.E.M. Corporation, East Norwalk, Conn.

Inhalation therapy

SEPTEMBER 1959

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JOURNAL OF THE AMERICAN ASSOCIATION OF INHALATION THERAPISTS

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Established 1956 and published quarterly at 332 South Michigan Avenue, Chicago 4, Illinois. Single copies \$1; subscriptions \$3 per year to non-members in the United States and Canada, \$4 elsewhere; \$2 to members (included in dues). © 1959 by the American Association of Inhalation Therapists. All rights reserved. Reproduction in whole or in part without the express, written permission of the Managing Editor is strictly prohibited.

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Disaster equipment must be simple

U. S. Air Force

by William H. Smith

PLANs FOR civil defense in the event of atomic or hydrogen bomb attack must consider definite equipment for treatment of nuclear bomb victims.

We in the Connecticut Civil Defense Health Service have developed methods and equipment to be used *specifically* for a disaster unit.

Our first problem was to prove a need for oxygen therapy equipment in the Civil Defense structure. The most frequent condition will be actual blast injuries to the lung. These injuries are caused by the

shock or pressure waves created by any explosion, and vary in intensity depending upon the subject's proximity to, and the nature of, the blast.

Lung damage is caused by two distinct pressure forces on the lung. The first is positive pressure outside the chest wall, and the second is a violent and almost equal positive pressure inside the chest. These are due to a rapid increase and decrease of the ambient pressure caused by the shock waves. The usual result is rupture, with accompanying hemorrhage.

There also is damage created by inhaling hot and possibly poisonous gases which can cause a massive edema with accompanying reduction of usable absorbing surface.

Next is the possibility of lung collapse due to punctures of the chest wall by flying debris or by the shock wave. Obstructions of the

Mr. Smith is in charge of research and development at the O.E.M. Corporation (Shampaine Industries), East Norwalk.



larynx, trachea or bronchi also are possible from these same causes.

Primary shock—a condition which always can be expected with physical injuries, while generally considered a circulatory disturbance—must be considered. Administration of inhalation therapy can be of great value in alleviating this dangerous condition.

The second problem is the person who will operate the equipment. When designing civil defense equipment, one of the most apparent differences from hospital equipment is the simplification of operating techniques. This, to many professional people, appears a poor practice in a field as technical as ours. We must remember, though, that the rescuer's training, mental state, and surrounding conditions are primary considerations for a device which is to be used by a volunteer. Quite probably, he or she will be relatively inexperienced.

Many problems face this volunteer worker following a disaster. Any additional burden placed upon him by controls or techniques can lead to confusion and panic. Since we were designing for adverse conditions, the worst possible situation was assumed.

Supplies are a problem

Another problem in connection with all departments of an emergency hospital unit is that of supplies. Emergency apparatus must be planned on the assumption that all communications and transportation facilities have been completely disrupted.

Since World War II, there have been many specialized devices developed for treating these various conditions. However, because these

devices are specialized and sometimes complicated, they were not considered suitable for true emergency use. It was agreed that an efficient, straightforward oxygen administering apparatus was needed. The basic problem is one of combat survival, and the most important job in combat hospital organization is to return as many people as possible to productive activity.

5,000 units are ready

Originally, Federal Civil Defense specifications for emergency oxygen therapy equipment called for a two-stage regulator with a double-bottle humidifier, catheters, a face cone and tubing. Over 5,000 such units have been purchased by Federal Civil Defense and will be used in case of any disaster requiring oxygen therapy.

However, we felt that this particular set-up was not very adaptable to the administration of oxygen under extreme disaster conditions. First, a catheter is a poor means of giving oxygen under these conditions because it takes a trained person to insert it properly, it requires frequent maintenance, and it requires some form of humidification. During disaster conditions, humidification may not be possible, since water supplies very often are contaminated. Also, humidifying units must be used in an upright position—a great inconvenience in some situations. All these points made clear the decision against the catheter.

The face tent was next considered. While this was an improvement over the catheter, it was ultimately rejected because it is too bulky, too expensive, and limited

continued on next page

to low oxygen concentrations. Another serious objection was that the majority of radiation victims are nauseated. A face tent can act as a reservoir from which a patient can aspirate vomitus. If he does not asphyxiate, he at least stands a good chance of developing some form of pneumonia.

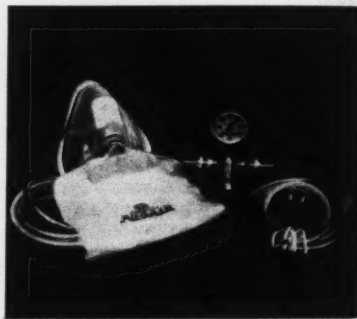
The plastic cannula then was considered. This seemed to offer the best solution. Anyone can apply it correctly; it is neat, light, small and inexpensive. The only drawback to the cannula was its inability to give high concentrations. This was solved by adding a disposable non-rebreathing face mask. By using both cannulas and masks, the need for humidification was eliminated. This is a big advantage, making the whole unit smaller.

Another factor to deal with is controlling the oxygen flow. In an emergency there is a definite possibility that very few professionals will be available. Since size and weight are important, it was decided that the single-stage type of regulator with a fixed-flow would be the most desirable. This created a few problems. The first was deciding on an optimal flow which could be used for both masks and cannulas. It was finally agreed this should be seven liters per minute. The next consideration was that since a fixed-flow single-stage regulator was desirable, a practical output flow range was necessary. In other words, because of the change in output flows with respect to cylinder pressures when using single stage regulators, allowances had to be made. The allowable range specified was a maximum output flow not to exceed nine liters per minute from a 2,200 pound full

cylinder, and a minimum output flow of not less than seven liters per minute from a 100 pound or "empty" cylinder.

It was found that a single-stage regulator can be made to keep within this tolerance. Since it was not adjustable, the need for a flow-meter was eliminated. The regulator is equipped with a double outlet so arranged that one or two patients can be treated from one cylinder.

Much time and thought also, was spent in selecting the materials for all components and accessories

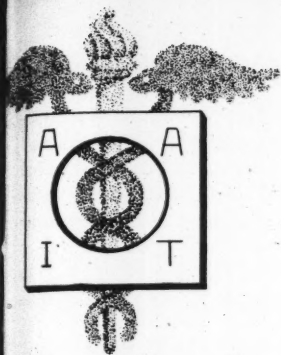


Disaster equipment must be stripped to bare essentials. This fixed-flow, single-stage regulator provides a 7 liter-per-minute flow to one or two patients using cannula or face mask. Humidifier is omitted because of the difficulty of obtaining uncontaminated water under emergency situations such as a bomb drop.

from the standpoint of shelf life—that is, the ability of a material to resist deterioration during long periods of storage. This also includes methods of packaging. With the emergency packs now devised, there is little fear that someone will open one, say 15 years from now, and find it useless because of deterioration or damage.

It is interesting to note that in both the New York State and the Federal Civilian Defense hospital units, there is only enough oxygen

see Smith—page 30



Fifth annual meeting will be the biggest and best yet!

by David Marshall

THE FIFTH Annual Meeting and Lecture Series of the American Association of Inhalation Therapists to be held at the Benjamin Franklin Hotel in Philadelphia from Monday, November 16 through Friday, November 20, will be the biggest and best yet!

Attendance at the meeting is expected to be more than 300 (we had 240 registrants in 1958 in St. Louis), the speakers and discussion leaders will be the top authorities in their fields, and there will be the largest exhibit hall in the AAIT's history with 25 companies displaying their products in 27 booths. (Last year we had 21 companies in 24 booths.)

The program will include lectures, roundtables, a field trip to a hospital, an "Exhibitors' Night" party where all registrants and speakers will be guests of the exhibitors, special sessions for the

service members, the annual meeting (which not only will elect new officers and directors but will consider some badly needed revisions and amendments to the AAIT national constitution and bylaws), plus an afternoon left open so that you may visit the historical sites in and around Philadelphia.

The first day of the convention—Monday, November 16—will open with registration at 9:00 a.m. and the initial speaker at 10:00 a.m. will be Dr. Albert H. Andrews, Jr. attending broncho-esophagologist, Presbyterian-St. Luke's Hospital of Chicago, discussing "Research Frontiers in Inhalation Therapy."

Dr. Andrews will be followed by John C. Carter, manager, oxygen therapy department, Linde Company, New York City, speaking on "What May Inhalation Therapy Expect from Industry" and then

continued on next page

Max E. Glasser, Professional Oxygen and Equipment Service, Miami, Florida, will talk about "What Can the Inhalation Therapist Expect from a Service Company."

At the opening luncheon on Monday, Norman R. Ingraham, M.D., Philadelphia's acting commissioner of public health, will welcome the registrants to the city.

Dr. Levine to speak

Then Edwin Rayner Levine, M.D., director, department of inhalation therapy, Edgewater Hospital, Chicago, Illinois, will speak on "The A.A.I.T.—A Heritage and a Future."

An innovation this year will be that the roundtable session, which has become a feature of the annual meetings, will be held in the afternoon of opening day so that more of the registrants will get to know each other better, sooner. In other years, this session has been held later in the week.

Again the moderator for the roundtables will be Mrs. Leah Tharaldson, C.R.N.A., director of inhalation therapy, Northwestern Hospital, Minneapolis, Minnesota.

The topics and discussion leaders are:

"Working with the Medical Director," Dr. Levine.

Inventories discussed

"Inventory Planning and Equipment Replacement," Mrs. Julia Craigie, supervisor of inhalation therapy, Northwestern Hospital, Minneapolis.

"Need, Time and Relative Cost of Gas Sterilization," Walter D. Moore, sales engineer, product application department, Wilmot Castle Company, Rochester, New York.

"Department Cleanliness and Equipment Sterilizing Techniques,"

James F. Whitacre, chief inhalation therapist, University Medical Center, Rochester, New York.

"Inhalation Therapy in the Small Hospital," Sister M. Regina Riley, O.S.B., R.N., B.S., supervisor, inhalation therapy, St. Joseph's Hospital, Brainerd, Minnesota.

"Training Auxiliary Teams in Basic Techniques," Donald Livingston, director of inhalation therapy, Charles T. Miller Hospital, St. Paul, Minnesota.

"IPPB Techniques and Trouble Shooting," Mrs. Agnes M. Forrest, supervisor, inhalation therapy department, Edgewater Hospital, Chicago.

Mrs. Grayson to talk

"Hot and/or Cold Humidity," Edward Leveille, supervisor, inhalation therapy, Presbyterian-St. Luke's Hospital, Chicago.

"The Therapist and the Nursing Team," Joan K. Grayson, R.N., consultant, oxygen therapy department, Linde Company, New York City.

"Records and Charges," Don E. Gilbert, chief inhalation therapist, University Medical Center, Ann Arbor, Michigan.

Tuesday's general session will open with a 9:00 a.m. talk by Peter A. Theodos, M.D., assistant professor of clinical medicine, Jefferson Medical College, Philadelphia, Pennsylvania, speaking on "The Physiologic Basis of Inhalation Therapy."

Then Dr. Levine will discuss "The Management of Bronchial Irritation and Spasmodic Cough" and Edwin Emma, M.D., chairman, committee on inhalation therapy, The American Society of Anesthesiologists, Inc., Hewlett, New York, will speak on "Resuscitation."

At Tuesday's luncheon Madison B. Brown, M.D., associate director, American Hospital Association, will talk about "The Professional Attitude—Does It Apply to Inhalation Therapists?"

More doctors scheduled

In the afternoon Hylan A. Bickerman, M.D., associate clinical professor of medicine, Columbia University, Columbia-Presbyterian Medical Center, New York City, will discuss "Heated Aerosols in Diagnosis and Therapy"; William F. Miller, M.D., director, pulmonary division, department of internal medicine, University of Texas Southwestern Medical School, Dallas, will describe "Heated Aerosols in IPPB Therapy"; and Theodore H. Noehren, M.D., assistant professor of medicine, Buffalo General Hospital, University of Buffalo (New York), will talk on "The Clinical Applications of Intermittent Positive Pressure Breathing (IPPB/I)".

That evening there will be held the informal party — "Exhibitors' Night" — where the exhibitors are hosts to all registrants and speakers.

Dr. Denton is next

Wednesday morning the session will open at 9 o'clock when Robert Denton, M.D., of the department of pediatrics, school of medicine, University of Pennsylvania, Philadelphia, will speak on "Practical Aspects of Inhalation Therapy in the Control of Acute Respiratory Diseases in the Pediatric Patient."

He will be followed by Vincent J. Collins, M.D., associate professor of anesthesiology, New York University Post-Graduate Medical School, New York City, discussing "Inhalation Therapy and Its Relation to Anesthesiology."

Then Stewart A. Wilber, M.D., assistant anesthesiologist, M. D. Anderson Hospital, The University of Texas, Houston, will talk on "For Want of Oxygen . . ."

At Wednesday's luncheon the registrants will hear from Albert Carrière, executive director of the A.A.I.T., Chicago, reporting on the progress of the association: "Let's Get Down to Cases."

Then the annual business meeting will be held with Mr. Gilbert, AAIT president, presiding. This meeting will include the reports of the president, chapter delegates, committees, and treasurer; a consideration by the members of revisions to the constitution and by-laws, and the annual election of officers.

Session to close early

Wednesday's afternoon session will close early—at 4 o'clock—so that everyone who has not seen them will have a one-hour last chance to visit the exhibits before they close. Exhibits will be open only on Tuesday and Wednesday, from 10 a.m. to 5 p.m.

Wednesday evening there will be a field trip, starting about 7:30 o'clock, to the Hospital of the University of Pennsylvania. Our host will be Robert L. Mayock, M.D., associate professor of clinical medicine and chief, pulmonary disease section, department of medicine, there.

Thursday morning's first speaker at 9 o'clock, will be Milton I. Levine, M.D., attending pediatrician and director of the children's pulmonary clinic, New York Hospital, New York City, who will speak on "Inhalation Therapy in Pediatrics."

continued on next page

Then Maurice S. Segal, M.D., clinical professor of medicine, Tufts University School of Medicine, and director, Tufts lung station and department of inhalation therapy, Boston (Massachusetts) City Hospital, will discuss "The Use of Home Aerosol and Suction Therapy."

Allan Hurst, M.D., director, inhalation therapy, General Rose and St. Anthony Hospitals, Denver, Colorado, will close the morning session talking about "Some Common Misconceptions About Inhalation Therapy."

The luncheon speaker on Thursday will be Kenneth L. Stratton, M.D., medical director, American Airlines, Inc., New York City, who will tell us something about the future in discussing "Oxygen and the Space Age."

Afternoon for exploring

Thursday afternoon, from 2 o'clock on, has been set aside for you to go exploring so that you can see some of the historical sites of Philadelphia, many of which are within easy walking distance of our hotel.

Nearby are such places of Americana as: Congress Hall, our national capital from 1790 to 1800; Betsy Ross House, where our first flag was commissioned; Carpenters' Hall, meeting place of the First Continental Congress; Old City Hall, where the first Supreme Court met; Christ Church, where Benjamin and Deborah Franklin are buried; The First Bank of the United States, the oldest banking building in America; and many more.

Walking tour guide booklets will be available at the registration desk

on the mezzanine each day during our meeting.

The final day of the meeting, Friday, the 20th, will open with Luther J. Platt, supervisor, inhalation therapy department, Memorial Hospital of Springfield, Illinois, speaking on "Inhalation Therapy and the Nursing Service."

Better records discussed

Larry Fruik, director of Aamed inhalation therapy in hospitals, Oak Park, Illinois, then will talk about "Better Standardization of Patient Records."

Howard W. Baker, M.D., administrator, Temple University Hospital, Philadelphia, will tell about "What a Hospital Administrator Expects from an Oxygen Technician"; Joseph J. Kloczek, R.N., supervisor of inhalation therapy, Presbyterian Hospital, New York City, will discuss "Inhalation Therapy Equipment—Its Maintenance and Storage"; and Gareth Gish, technical representative, research and development department, Puritan Compressed Gas Corporation, Kansas City, Missouri, will speak on "The Inhalation Therapist and Research."

Final session is Friday

For the final session of the meeting—Friday's luncheon—S. Walter Foulkrod, Jr., attorney at law, Philadelphia, will speak on "Legal Responsibilities of the Inhalation Therapist."

The Fifth Annual Meeting will close at 2 p.m.

The service members will hold their annual meeting for their membership on Sunday afternoon, November 15, beginning with a business program at 1 o'clock. There then will be four one-hour group

discussions with these topics and moderators:

"Insurance," George Marson, Gates Ambulance and Oxygen Service, Incorporated, Ridgewood, New York; — "Inter-service Company Relations," Ross J. Hawkes, Hawkes Ambulance Service, Inc., New York City; — "Operating Room Procedure," Mr. Glasser; and — "Unusual Inhalation Therapy Problems," Robert L. Kruse, Aamed, Inc., Oak Park, Illinois.

The service members' annual breakfast will be Wednesday morning, and their banquet on Thursday evening.

Other annual meeting features will include the industrial members' breakfast on Tuesday, the annual board of directors' and board of advisors' meetings, and conferences for members with the executive director.

Registration fees for the annual meeting and lecture series are: Members: \$40—non-members: \$50. These cover admission to all sessions, five luncheons, the field trip, and admission to the exhibits.

Complete printed programs will be sent to all members in advance

of the meeting so that they may register.

For any additional information, write to:

Albert Carrière, Executive Director, American Association of Inhalation Therapists, 332 South Michigan Avenue, Chicago 4, Illinois.

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AMERICAN ASSOCIATION OF INHALATION THERAPISTS

THE AMERICAN ASSOCIATION OF INHALATION THERAPISTS is an organization of therapy technicians working: in hospitals, for firms providing emergency therapy service, and for municipal organizations. The Association is sponsored jointly by the American College of Chest Physicians and the American Society of Anesthesiologists.



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How to staff and operate the full-time, trained department

by Don E. Gilbert

IN THE experience of many hospitals it has been found that any other arrangement (such as "glorified" orderlies, nurse aides, central supply nurses, or even part-time therapists) in place of a bona fide full-time, fully-trained crew of inhalation therapists usually fails miserably after a few weeks or months.

These are the reasons why hospitals need inhalation therapy departments:

1. a. Savings in equipment because of better care and less equipment loss.

- b. Added revenue because one person is responsible to see that every use of inhalation therapy equipment or service is charged for. When charging is left up to the floor nurses or other personnel, more often than not they either forget to charge at all because of

their concern for the many other facets of patient care, or they err by mischarging.

- c. In purchasing equipment without a trained therapist's guidance, hospitals often overbuy on expensive, little-used equipment. Instances have been demonstrated where a misguided nurse or doctor who listened to the sales pitch bought a \$750 or \$800 device that does not do as good a job as a \$30 or \$40 device in the hands of a competent therapist.

2. In assisting and diplomatically suggesting to doctors different treatments or improvisations on treatments, the therapists can improve on the effectiveness of therapy.

3. Safety hazards go down if some one person is responsible for handling the gases and treatments; and for enforcing "no smoking" regulations.

After an inhalation therapy department has been functioning for a few months, the rest of the staff will begin to appreciate this type of service, and respect the therapists' knowledge of their techniques and equipment. Then the hospital

Mr. Gilbert is supervisor of inhalation therapy at University Hospital, Ann Arbor, Michigan, and is president of the American Association of Inhalation Therapists.



will experience a healthy increase in the number of active inhalation therapy cases.

An absolute minimum crew to cover 24-hour, seven-day service is four therapists. The chief therapist works days and supervises the department, trains his men, keeps records and charges for services. (He should have an assistant who will work days with him and replace him for sick time, vacations, etc., but this assistant can be added to the staff later.) An evening therapist (4:00 p.m. to midnight), a night therapist (midnight to 8:00 a.m.), and a relief therapist to work when the others have days off complete the minimal staff. A sample work schedule is given in the Table.

record of all the equipment in use will be kept. That patient will be visited every eight hours as long as he has equipment by his bed, whether in use or not. These are routine rounds, and the patient will be seen oftener as needed, within the limitations of the therapists' freedom from other responsibilities.

When discontinued, equipment immediately will be removed and returned to the department headquarters for thorough disassembly, cleaning, reassembly, checking and repairing where needed, and stored. Safety rules will be enforced at all times. The patient's response to treatment will be noted and—especially if not satisfactory—will be reported to the doctor and sugges-

Scheduling of four employees to cover 7-day, 24-hour service.

THERAPIST	MON	TUES	WED	THURS	FRI	SAT	SUN
Day (Chief)	8-4	8-4	8-4	8-4	8-4	off	off
Evening	off	off	4-12	4-12	4-12	4-12	4-12
Night	12-8	12-8	off	off	12-8	12-8	12-8
Relief	4-12	4-12	12-8	12-8	off	8-4	8-4

In this example the relief man worked 48 hours; however if the evening, night and relief men take turns having only one day off in the week, each man will catch the 48-hour trick only every third week. This also can be avoided by rotating through the three jobs.

Naturally, as soon as the department is functioning, the fifth therapist should be put on, so that an uninterrupted schedule is maintained even during vacations, sickness, etc.

The trained therapist shall, on doctor's order, take all necessary equipment to the patient's bedside and initiate the therapy. A case record form of some type will be made out on that patient, and a

tions submitted for a more effective treatment.

In case of certain types of therapy such as masks that require constant attention, the therapist will give necessary instructions to the attending nurse.

Because of the possibility in the future of a registry for inhalation therapists being established nationally, and the definite requirement that the therapist to qualify must have gained experience while working under a qualified physician, I would suggest the best step is to have a doctor as the department head or consultant. Since the American Association of Inhalation Therapists is co-sponsored by the

continued on page 29



Closed breathing apparatus will help put animals

by Paul Webb, M.D.

EVER SINCE the early days of balloon flights, supplementary oxygen has been used in flights above 12,000 to 15,000 feet.

The early devices were crude, consisting of pipe stems leading from the oxygen store to the flyer's mouth. The familiar BLB mask was used later to deliver a richer oxygen mixture. During World War II, complete face masks and efficient regulators were developed which could deliver either oxygen-enriched atmospheres or pure oxygen. The last step was the development of continual positive pressure breathing for flights beyond 40,000 feet. This allowed flights of long duration at altitudes up to 45,000 feet.

Another line of development in maintaining man at high altitude was the pressurized cabin, using air which had been compressed until it was effectively equivalent to air at much lower altitude. Pressurized suits to do essentially the same job have also been under study for some years, and newest models of

ngating system

man in space

Air Force and Navy full pressure suits look very promising.

Today's civilian and military aircraft use pressurized cabins. The source of air within the cabin is the thin atmosphere outside, which is scooped in, compressed, cooled, and then delivered at a rate sufficient to over-balance the leakage rate from the cabin. This works well up to an altitude of approximately 80,000 feet. At higher levels, the air is so thin that it cannot be efficiently collected and compressed.

At such altitudes, then, a sealed cabin or a sealed, pressurized suit must be used. In either case, the supply of gas contained in the sealed space, and the means for renewal of that gas, must be carried along with the vehicle.

Putting a man into a truly sealed space brings special problems too. It should be apparent that since the

man may occupy this artificial atmosphere for long periods of time, not only must his respiratory requirements be met, but also the other functions of the atmosphere we live in must be recognized and designed for. The air around us is the primary means for carrying off the heat produced by our bodies and the water vapor which escapes from skin and lungs. The pressure of air is something to which we are accustomed, and to which our soft skin covering is adjusted. All of these needs should be met in devising an artificial atmosphere.

Up to the present time, an "open" breathing system has been used in aircraft. The inspired gas, whether air, air enriched with oxygen, or pure oxygen, is used once and the expired volume exhausted overboard. This approach works quite well for aircraft that fly for relatively short times or fly a good part of the time at low altitudes. However, for flights of long duration and at very high altitude, the requirement to carry enough gas to supply the respiratory ventilation rate at 10 liters per minute, would impose a serious weight penalty.

Dr. Webb is a consultant to the aviation industry. He formerly was chief of the environment section, Aero Medical Laboratory, Wright Air Development Center at Dayton, Ohio.



continued on page 24

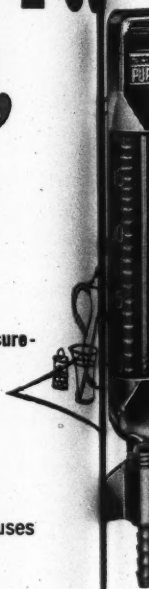
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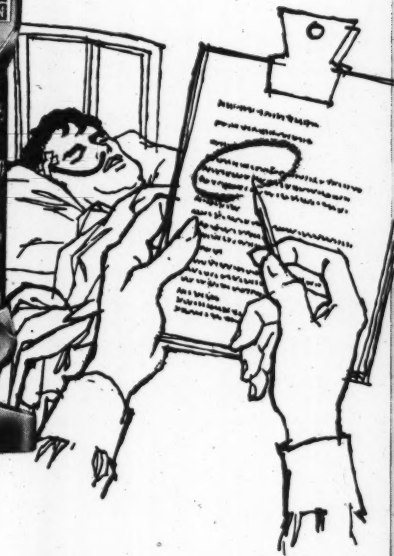
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continued from page 21

In a closed breathing system, such as is used in anesthesia machines, the carbon dioxide is absorbed from the expired air and oxygen added at a rate sufficient to make up what was actually consumed. Consumption rate of oxygen is about 1/10 of the respiratory ventilation rate. The techniques for

required. Today's aircraft have an ample supply of air from the large compressors in the jet engines. However, at very high altitudes where turbo-jet engines are no longer efficient, and also in space vehicles, the penalty for carrying this much air over a long period of time would obviously be excessive. One pound per minute multiplied

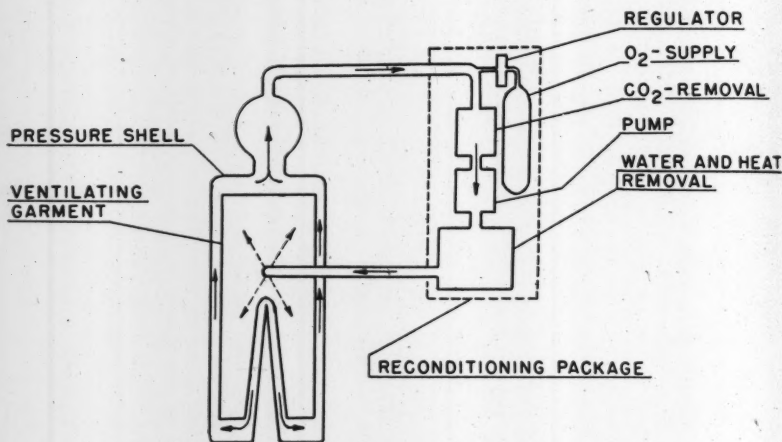


Fig. 1. Closed Circuit Breathing-Ventilating System

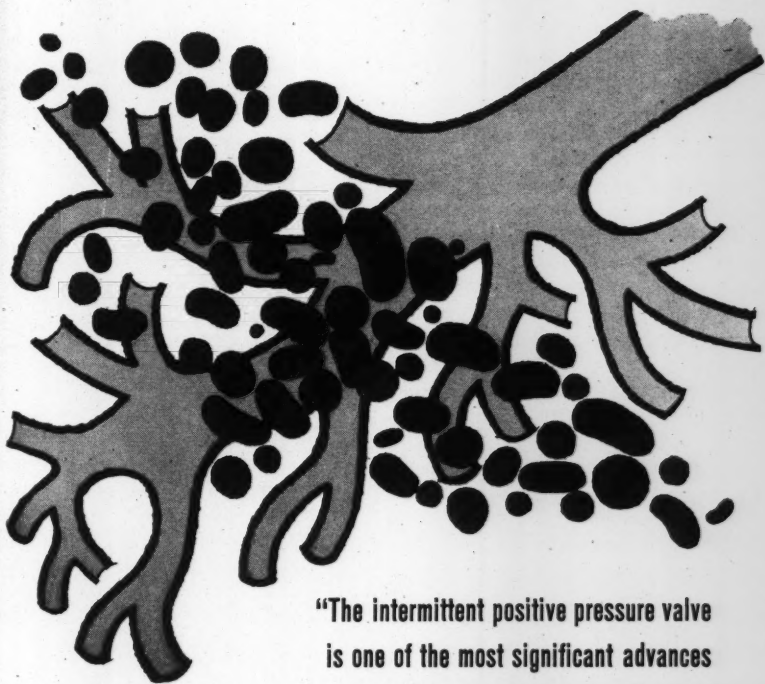
achieving a closed breathing system are well known; anesthesia machines and clinical BMR machines have employed them for many years. The primary advantage in aviation for using a closed system is in the economy of stored gas required.

Present day systems for supplying fresh air to aircraft or to pressure suits deliver the required gas volume, let it pass once through the space to be ventilated, and then exhaust it overboard. For a whole aircraft cabin, this requires an air supply at the rate of about 10 lbs. of air per minute. In a pressure suit, up to 1 lb. of air per minute is

by 24 hours would be far too much of a burden for a light-weight vehicle placed in orbit. The obvious approach is to use the same volume of gas over and over in a closed recirculating system.

A single gas circuit can very nicely satisfy both the respiratory and ventilatory requirements for a man. Figure 1 diagrams the system. The man occupies a small closed space, into which the gas is delivered. It is spread over his body surface for the purpose of cooling and removing water vapor from his skin. The same gas travels past his head, and he breathes from the

continued on page 26



"The intermittent positive pressure valve is one of the most significant advances in recent years in the treatment of chronic bronchitis. Designed to apply a controlled pressure in inspiration to the inspired gas, to cycle at the patient's will, and to apply aerosolized medications, it is a major triumph of medical engineering."

—Farber, S. M.; Wilson, R. H. L.; and Smith, J. D.: California M. 84:101 (Feb.) 1956.

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continued from page 24

free volume contained within the space. The circulation rate is approximately 10 cubic feet (300 liters) per minute, so there is always more than enough refreshed air for breathing. The addition of moisture and heat from the man's surface does not hamper the utility of the air for breathing.

Air is conducted from the space occupied by the man to a package where reconditioning and reconstitution take place. The contents of this unit are:

- 1) An oxygen supply sufficient to meet the consumption rate of the man for the period of use, with a regulator for metering the gas and maintaining the desired pressure in the system.

- 2) A canister of lithium hydroxide for CO_2 removal. This chemical has been chosen because of its very light weight and high efficiency in absorbing CO_2 .

- 3) A gas-circulating pump.

- 4) A cooling device with a store of an expendable cooling medium which is used up at rates calculated to meet the cooling needs of the man during the whole period of flight, including those times when extreme heating might occur.

Each of these items has been especially developed to work automatically and reliably, and to occupy a very small space.

This system was first made in rather crude form at the Air Force Aero Medical Laboratory, Wright Air Development Center, several years ago. Tests made in altitude/temperature chambers were so promising that the Air Force supported an engineering design study of the equipment, which was carried out at the Central Research Laboratories of the Air Reduction

Company in Murray Hill, New Jersey. The idea was to improve the equipment and make it suitable for use in aircraft. Also involved were special pump and cooler developments, done by the Task Corporation, Anaheim, California, and Research, Incorporated, Hopkins, Minnesota.

We hoped to compress the stored oxygen and expendable coolant, the pump, the lithium hydroxide cartridge, the pressure regulator and the cooler all into a small package which could then become almost an item of personal equipment rather than a large piece of machinery installed in the airplane.

Would protect the man

The package was designed to suit an imagined vehicle which would leave the earth's atmosphere, orbit for about half a day, and return again to earth, protecting the man and supplying him with necessary oxygen and cooling for that period. It is shown in Figure 2 (page 28) and on page 20.

The metal box is largely made up of expendable coolant (water, which boils at the low pressure of space) and heat exchangers for using the heat energy to cool the oxygen stream. The lid (Figure 2) has been raised over the ice storage compartment. The machinery mounted in a pullout arrangement in the center of the box contains most of the working equipment.

Carbon dioxide absorption is carried out in a cylindrical canister filled with lithium hydroxide. Water vapor and heat are removed in the heat exchangers lying out in the main part of the metal box. Oxygen is stored in a very small metal cylinder located in the main

concluded on page 28

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equipment package. The pressure of oxygen in the cylinder is 7500 psi, a figure chosen to represent the maximum saving in both weight and volume for the amount of gas needed.

Also located in the pull-out frame are the pump for circulating the oxygen around the closed circuit, and the regulator for maintaining pressure in the circuit by supplying oxygen as it is consumed by the man.

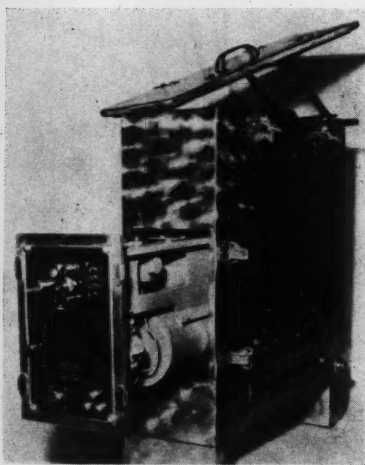


Fig. 2. Closed Cycle Breathing/Ventilation System Assembly to provide necessary oxygen and cooling for a man in orbit for half a day.

This apparatus has been used in test chambers, and so far it appears that the functions of life support, respiratory balance and thermal balance have all been met satisfactorily in this design.

The development as described so far has not involved much in the way of new approaches, but rather adaptation and special engineering of known approaches. There are fascinating problems to be solved in the near future. For example, the

present method for removing CO_2 requires a chemical bed, the size of which must be bigger and bigger as the time of flight becomes longer. New ways of getting rid of it will include perhaps the breakage of the CO_2 molecule into usable oxygen and a carbon-containing waste product.

In my opinion, this will probably be accomplished and in use as a chemical process before we are able to make use of a natural photosynthetic process. While the use of algae for converting CO_2 to oxygen and foodstuff is being explored by Air Force laboratories, there are very great problems in adapting such a system to space vehicles.

Future developments should consider the economy of substances in very long flight. A natural sequence of progression is apparent, in which water will be the first item to be saved rather than expended, gas next, and finally foodstuff. When all three of these elements must be preserved in order to make a flight possible, the system then becomes a completely closed ecology. The ultimate—a closed ecological system—is a goal to be pursued, but because of the complexity of the control problems within it, a goal which is still rather far in the future.

Meanwhile, we have begun to fly to very high altitudes, or essentially to space. When you hear of the successful flight and return of animals and eventually man, you will understand that the atmosphere which supported life was maintained by a system basically similar to the one you have read about here.

This article is based on material which was presented to the Aero Medical Association in 1958, and published in *Astronautics*, February, 1959.

American Society of Anesthesiologists and the American College of Chest Physicians, it follows that an anesthesiologist or a chest physician would be the logical choice.

However, of utmost importance to the success of this department is that whoever the doctor is who heads it, he must really be interested in inhalation therapy, and must be available for consultation when the therapists need him.

Setting Up A Patient Charging System. Most of the large gas suppliers have worked out cost analyses which are valuable in trying to arrive at a fair charging formula. Things which any system has to take into account are:

1. We are *not selling* oxygen, tents, or any other equipment to the patient. Actually we are giving *therapy*, and for this service we are involved in certain costs—among them the amortization of expensive equipment.

2. Purchase of oxygen and other gases such as $\text{CO}_2\text{-O}_2$, He-O_2 , etc.

3. Cost of disposable and expendable equipment—masks, canopies, tubing, cleaning and packaging supplies, office supplies, etc.

4. The department's share of physical plant operating expense: Telephone and other utilities, space rental, storage facilities, and special facilities installed expressly for the department.

5. The most expensive item—trained personnel to operate the service.

The most trouble-free, simple and fair charging formula might be called a "time and equipment" system. It works this way:

When any type of equipment is installed by the therapist, a \$3 set-up charge is initiated. Then an additional charge is made for the amount of time the equipment is used. We have found that a step-wise increase for each eight hours of use is easier and presents less possibility of error, and the patient is less likely to be unhappy with it, than with a straight hourly charge.

For a mask, nasal catheter, incubator or croupette, there is the initial set-up charge of \$3, and for from one to eight hours use, \$5 more is charged. If the equipment is used nine hours but less than 17, the additional charge is \$7; for over 17 hours and up to 24 hours use, \$10 is charged.

For adult tents a higher rate applies, and for special treatments like IPPB, a separate charge schedule is established.

Here is an example of how the patient is charged. Assume Mr. Smith has a nasal catheter started at one o'clock in the morning. At 8:00 a.m. that day the chief therapist makes his rounds and charges, so Mr. Smith is charged \$3 set-up fee and \$4 for seven hours' use. At the next morning's rounds, charges on all active cases are made again. Mr. Smith has been using his catheter continuously, so he gets charged \$10 for 24 hours' use.

Care of Equipment. Equipment maintenance is of course reduced to a minimum with trained personnel handling the apparatus, cleaning it and routinely checking it. A good preventive maintenance arrangement with the hospital engi-

Smith—from page 12

equipment to treat five per cent of the total number of patients each hospital is equipped to handle. With all the conditions that can require oxygen therapy, this seems very low. Authorities feel that only those that need oxygen to maintain life will receive it.

It should be pointed out that we have discussed only one emergency inhalation unit, which we submitted especially for civilian defense use. For the present this system appears most useful; however, in the past 10 years our field has developed rapidly in methods and concepts. Much basic research is going on. I don't think anyone can predict what might be developed by 1969.

Gilbert—from page 29

neering department generally takes care of such problems as arise with oxygen tent refrigeration systems, or other mechanical or electrical disorders. Pressure regulators or other highly specialized equipment like IPPB apparatus should of course only be repaired by the manufacturer.

It is almost impossible to tell exactly—or even make a close guess—what the savings of such a department are to the institution, but we are sure they exist. The main thing to keep in mind is, we are giving safer and more effective therapy at a fair charge to the patient. In a period of time, this revenue balances out with our expenses by a safe margin.

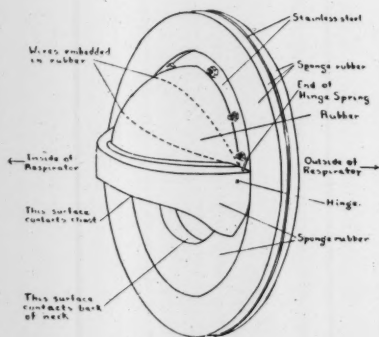
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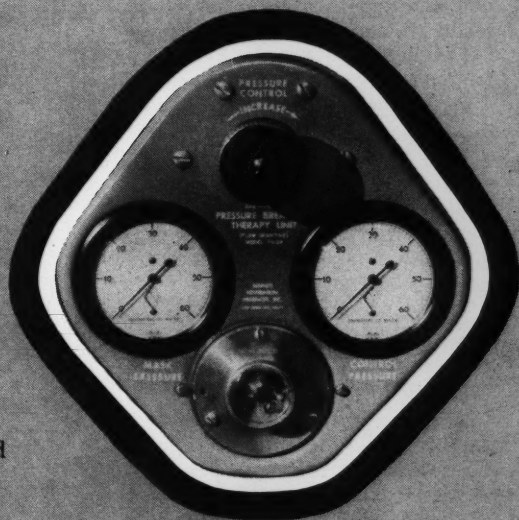
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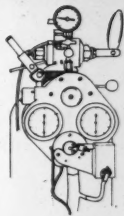
Adaptations of this famous basic unit are illustrated below. We invite you to write for literature and reprints or demonstration.



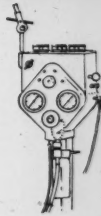
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CHAPTER ACTIVITIES

by Jack Sangster

FOR THE third successive issue we can report formation of a new chapter—the **Wisconsin Chapter** in Milwaukee, which brings our total chapters throughout the United States and Canada to 18!

Others are being formed, so we'll soon pass the 20 mark.

Miss Dorothy Braeger, R. N., supervisor of the inhalation therapy department at Milwaukee Hospital, is the chapter's first president. Vice president is Sister Mary Mercita, O.S.F., supervisor of inhalation therapy at Trinity Memorial Hospital, Cudahy. Thomas W. Goggins, R.N.A., St. Luke's Hospital, Milwaukee, is treasurer; and R. C. Berry, product engineer, Ohio Chemical & Surgical Equipment Company, Madison, is secretary.

The chapter's medical advisor is Richard P. Jahn, M.D.

New officers elected at the annual meeting of the **Upper Midwest Chapter** are: Sister Mary Regina Riley, O.S.B., supervisor, St. Joseph's Hospital, Brainerd, Minnesota, president; Sister Mary Lucida, C.S.J., supervisor, St. Michael's Hospital, Grand Forks, North Dakota, vice president; and Mrs. Shirley Bell, instructor, school of anesthesia, Northwestern Hospital, Minneapolis, secretary-treasurer.

The **Florida Society of Inhalation Therapists** met in May at the Coral Gables Veterans Administration Hospital to hear George Baum, M.D., talk on "Pulmonary Function and the Newer Aspects of IPPB Therapy."

The **Bay County (Michigan) Chapter** is planning a one-day institute to be held this fall. The July meeting featured showing of a film, "Recognition of Respiratory Acidosis."

The **Greater New York Chapter** elected Warren H. Greer, Englewood (New Jersey) Hospital, as secretary to replace Leslie H. Freedman who has moved to the Walter Reed Army Hospital, in Washington, D. C. The chapter's April meeting was addressed by Hylan A. Bickerman, M.D., Columbia University department of medicine, on "New Methods of Treatment in Chest Disease." The May meeting featured a talk by William Gruen of Instrumentation Associates on "Practical Physiological Discussion on Equipment Measuring Lung Function."

The **Delaware Valley Chapter** met in June at the Albert Einstein Medical Center (Northern Division) in Philadelphia. Philip Kimble, M.D., spoke on "Cardiac Pulmonary Conditions in Relation to Inhalation Therapy."

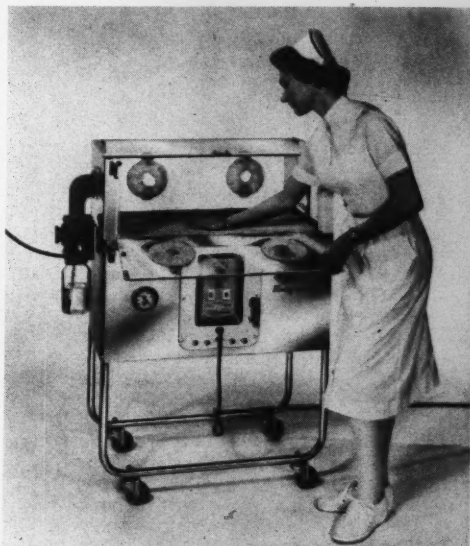
The **Greater Montreal Chapter** in May met at the Ottawa Civic Hospital where Goodman Cohen, M.D., head of the pulmonary function laboratories there, spoke on the "Work of Breathing." Robert K. Merry, chief therapist, Royal Victoria Hospital, reported on the inhalation therapy school at his hospital. The chapter's April meeting was held at Montreal General Hospital to hear Robert Ferguson, M.D., director of anesthesia, speak on "General Physiology of the Body in Relation to Oxygen Therapy Needs."

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EDITOR'S CORNER

Five Years of Changes

FIVE YEARS ago a lot of patients in our hospital were using hand nebulizers (driven by oxygen), and there were no large volume aerosol generators—they were just becoming available.

Now I have almost nobody using hand nebulizers of this type, but do have patients using aerosol generators with either face or tracheotomy masks. Hand bulb nebulizers are still used, of course, for bronchodilator administration where this department isn't even consulted, and small oxygen-driven nebulizers are on all the IPPB apparatus, but the day of this sort of nebulizer being used by itself seems to be going out in this hospital.

As for IPPB, I'm sure that probably has grown faster in most departments than any other modality of therapy in the past five years. We have only been doing it for three years, and have already gone from about 1,800 treatments the first year to more than 5,000 the past year, with expansion from house patients to outpatient service as well.

Now furnish their own

Another difference is in the use of CO_2 - O_2 mixtures; we used to have people being hyperventilated by mask with 5-95% or 10-90% mixtures for *days*—dozens of them each month! Now there aren't more than eight or 10 calls for CO_2 - O_2 in a year; most of the patients requiring hyperventilation are furnishing their own 5% CO_2 by rebreathing from a dead space tube, which is successor to the old paper bag. The difficult ones, of course, get the more thorough-going ven-



tilation afforded by IPPB, but neither our staff nor our equipment is yet at the point where we can use IPPB routinely on all post-op hyperventilations. Anyway, CO_2 now seems limited here to use in relief of cerebral vessel spasm, or an occasional try at obstinate hiccoughs.

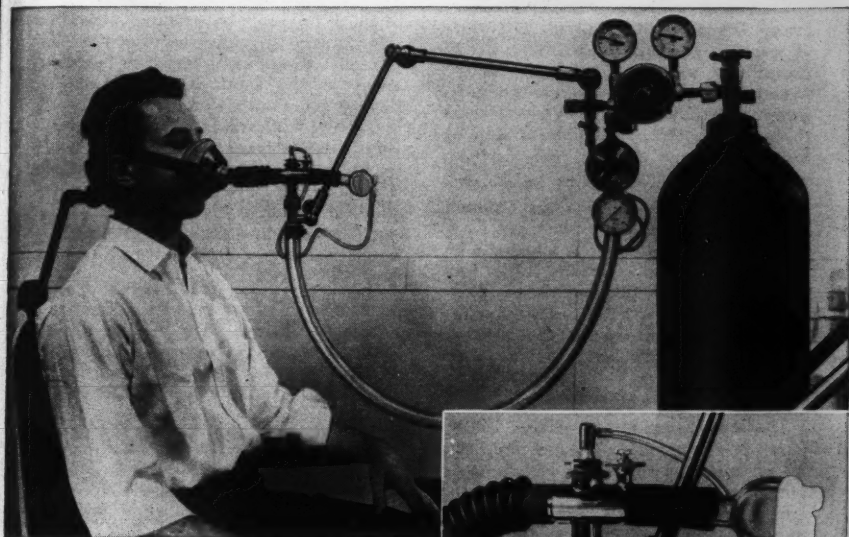
Iron lung use drops

Five years ago we had been having four or five paralytic polios in iron lungs every year. This has steadily decreased, thanks to the Salk vaccine; however, during the same time we have seen more and more emphysema cases get into CO_2 narcosis and have to be put into respirators to help them get rid of CO_2 .

There is a very interesting comment to make in this connection, and that is that the majority of cases like this would be better served by one of the respiration assistants connected to the airway than by a full tank respirator; however, it is a problem to find special nurses around the clock who are familiar with the operation of such machines, whereas they *have* had experience with iron lungs! I would like to emphasize that I am speaking only from my experience *here*, but I suspect this is the case in many other hospitals as well. Wherever this is the situation, the full tank respirator probably remains a safer expedient.

With the advent of a newer and better means of sealing the collar of the respirator, though, one of the biggest bugaboos of iron lungs (difficulties with the collar) is largely removed. (see *INHALATION THERAPY*, June 1958).

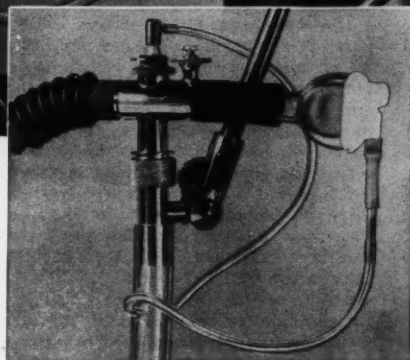
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WORTH NOTING

"Pulmonary Hypertension," by Paul Wood, in *Modern Concepts of Cardiovascular Disease*, 28:513, 1959.

The blood pressure of the pulmonary circuit is normally only about 25/10 mm of mercury, as opposed to the systemic pressure of around 120/80. Pulmonary hypertension is present when the pressures are 50/25 or above. In severe cases the pulmonary blood pressure may be as high as systemic pressure, but rarely in excess of 150 mm mercury.

Dr. Wood's article discusses different types and causes of pulmonary high blood pressure. It may be due to high pulmonary venous pressure, high pulmonary blood flow or high vascular resistance due to obstructions. The obstructions may be from external pressures or internal clots or structural changes in the vessel walls, or may be merely the result of a functional vasoconstriction.

However it gets started, pulmonary hypertension seems to be perpetuated first by vasoconstriction, which is reversible, but later by structural changes in the arterial walls—chiefly enlargement of muscle layers and invasion by fibrous connective tissue. Finally, there develop secondary thrombo-obstructive lesions (clots) in the lumina of the vessels. Hence in the early stages it is a reversible process if the primary causative factor can be found and eliminated; but the later stages are irreversible, leading to death from congestive failure. This can be staved off for several years by recourse to permanent anti-coagulation to prevent thrombosis, pulmonary vessel dilators such as reserpine and aminophylline, and modern methods of controlling heart failure.

"Application of Abdominal Pressure for Artificial Respiration," by J. Patrick Adamson, M.D., Leon Lewis, M.D. and Jerome D. Stein, M.D., in *J.A.M.A.* 169:153, 1959. *J.A.M.A.* editor's summary:

"A method of providing long-term respiratory assistance by intermittent abdominal pressure was tested in 15 patients with respiratory paralysis of different degrees of severity. Effective artificial

respiration was provided by means of rhythmic inflation of a rubber bladder incorporated in an abdominal corset. A positive displacement pump powered by line current or 24-volt battery connects to the respirator by means of a flexible plastic hose. Active assisted expiration is followed by passive inspiration due to gravitational pull on the diaphragm. Ventilation improves progressively as the trunk is flexed from 30 degrees to an optimal angle of 75 degrees above the horizontal. It was not necessary to exceed pressure of 50 cm of water at 16 cycles per minute in any patient. This method increased the range of physical activities and improved vocational potentialities for those needing life-long respiratory assistance after they have had poliomyelitis."

"Oxygen Therapy and Allied Physiologically Based Procedures in Pulmonary Emphysema," by Alvan L. Barach, M.D., in *Minnesota Medicine*, 42:272, 1959.

Dr. Barach makes a plea for a sensible approach to the use of oxygen for emphysematous patients, and mentions other means based on physiological principles for assisting ventilation. He says, in part, "So many warnings have appeared concerning 'oxygen poisoning' and specifically against the use of oxygen in chronic pulmonary emphysema that patients have at times endured a dangerous degree of hypoxia. . . . Abrupt administration of 40 to 100% oxygen to cases of diffuse obstructive bullous emphysema constitutes overdosage of oxygen, which in this clinical entity is then followed by respiratory depression, and a clinical train of symptoms due to acid shift in pH and uncompensated respiratory acidosis. The hazards of this kind of oxygen therapy have too often been proclaimed without at the same time describing the proper method of administration. . . . The patient is not treated with concentrations over 30% . . . until after three or four days previous acclimatization to lower oxygen percentages. One or two liters per minute . . . is sufficient to increase the arterial pO_2 considerably in the presence of severe hypoxia, without respiratory depression, provided sedation is given under skillful management to avoid exaggerating the narcotic tendencies of acid shift in pH."

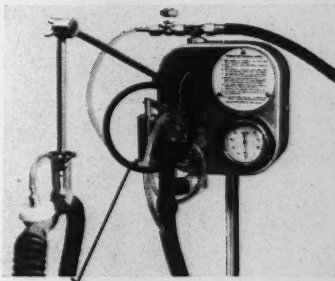
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EQUIPMENT NEWS

(Information and photographs are supplied by the manufacturers or distributors)

NCG's OB Resuscitator

National Cylinder Gas Division of Chemetron Corporation, Chicago, has announced the release of a new obstetric resuscitator for newborns which is reported to be so delicate it can work on



a mouse or small bird. The Handy OB Resuscitator, built for NCG by the Stanton Scientific Company, Glendale, California, is so sensitive it can gently force air through an opening the size of a

pinhole, and automatically adjusts to lung capacity as small as that of a mouse or parakeet. When an infant's airway is almost completely filled with mucus or other material or when the walls are kinked or partially collapsed, this resuscitator will supply oxygen if there is the tiniest opening. Conventional resuscitators fail if the airway is blocked. After the air passageway is cleared, the instrument can be switched to inhalation operation.

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The Thompson Medi-Breather, manufactured by the Thompson Engineering Products Company of Boulder, Colorado, is a compact, convenient device for the administration of positive pressure therapy using room air. Two separate air pumps provide air at proper pressures and volumes for breathing and also at proper pressures and volumes for nebulizer operation. Treatment air pressure is quickly and easily adjustable to any desired value between 5 and 35 cm of water. It is possible to adjust flow rate independently of pressure.



The machine delivers air continuously, and is made intermittent by the user or attendant, using one of several very simple techniques. It operates from 120 volt house current. It is packaged in a light but rugged case, the complete unit weighing only 16 pounds.

Oxygen may be added to the air from the machine either through the nebulizer or directly into a tee in the outlet line. However, the major advantages of this device are its portability and economy of operation, characterized by freedom from use of high pressure tanks. No. 432

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